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NAVAL AIR TEST CENTER

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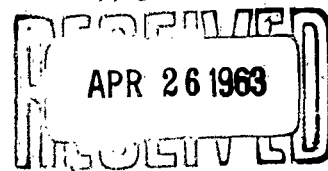
Report

WEPTASK NO. RA1200001/2011/F012 15 02

PROBLEM ASSIGNMENT NO. RAE331-147

FIT CHECK AND FLIGHT TEST OF UNIVERSAL
AIR REFUELING DROGUE;REPORT #1, FINAL REPORT

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SERVICE TEST DIVISION

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NAVAL AIR TEST CENTER
U. S. NAVAL AIR STATION
PATUXENT RIVER, MARYLAND

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WEPTASK NO. RA1200001/2011/F012 15 02, PROBLEM ASSIGN-
MENT NO. RAE331-147, FIT CHECK AND FLIGHT TEST OF
UNIVERSAL AIR REFUELING DROGUE; REPORT #1, FINAL REPORT



ABSTRACT

1. The Service Test Division conducted an evaluation of a prototype universal air refueling drogue manufactured by Beech Aircraft Corporation, to determine its compatibility with all available Navy air refueling systems. The prototype was physically compatible with systems tested, however, a single flight revealed serious design deficiencies in structural integrity and stability, correction of which is mandatory for satisfactory service use. It is recommended that the Beech Model 485 universal drogue not be accepted for service use in its present configuration, and that research and development be continued to obtain a satisfactory universal drogue.

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REPORT #1, FINAL REPORT

ON

WEPTASK NO. RA1200001/2011/F012 15 02,
PROBLEM ASSIGNMENT NO. RAE331-147

FIT CHECK AND FLIGHT TEST
OF UNIVERSAL AIR REFUELING DROGUE

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RAE331-147 NAVAL AIR TEST CENTER
ST31-185 U. S. NAVAL AIR STATION
 PATUXENT RIVER, MARYLAND

17 Apr 1963

From: Commander, Naval Air Test Center
To: Chief, Bureau of Naval Weapons

Subj: WEPTASK No. RA1200001/2011/F012 15 02, Problem
Assignment No. RAE331-147, Fit Check and Flight
Test of Universal Air Refueling Drogue; Report #1,
Final Report

Ref: (a) WEPTASK No. RA1200001/2011/F012 15 02, Problem
Assignment No. RAE331-147 of 13 Sep 1962
(b) BuWeps ltr RAAE-331/92:POL of 23 Oct 1962

INTRODUCTION AND PURPOSE

1. The subject problem assignment was established in references (a) and (b) with a NORMAL effort level to determine the compatibility of a universal air refueling (AR) drogue with all available Navy AR systems.

DESCRIPTION OF TEST EQUIPMENT

2. Universal AR Drogue. The prototype universal AR drogue (Beech model 485), manufactured by Beech Aircraft Corporation, was designed for use in any existing Navy AR system. The design incorporated features to facilitate maintenance and interchangeability of parts.

3. The test drogue had three basic parts: an annular parachute, a mounting ring, and adjustable leaves which connected the parachute to the mounting ring. The annular parachute had three cables as edge members in lieu of conventional cord. The mounting ring (figure 1) was a single aluminum casting with integrally cast hinge pins. Each leaf consisted of two aluminum channels with a flat bar link forming an adjustable triangle (figure 2). The leaves were joined to the mounting ring by hooking them to the hinge pins in a horizontal position and then raising them vertically (figure 1) to receive the cables of the parachute. A straight-headed pin and a cotter pin closed the assembly in one of four drag configurations (figure 2). The leaves were equally spaced about the cables by trapping them between equally-spaced steel balls which were swaged to the cables.

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The drogue was attached to a standard MA-2 reception coupling by eight mounting bolts. Either the complete drogue or any part was replaceable while the drogue was attached to the MA-2 coupling. The leaves were painted with a reflective white finish.

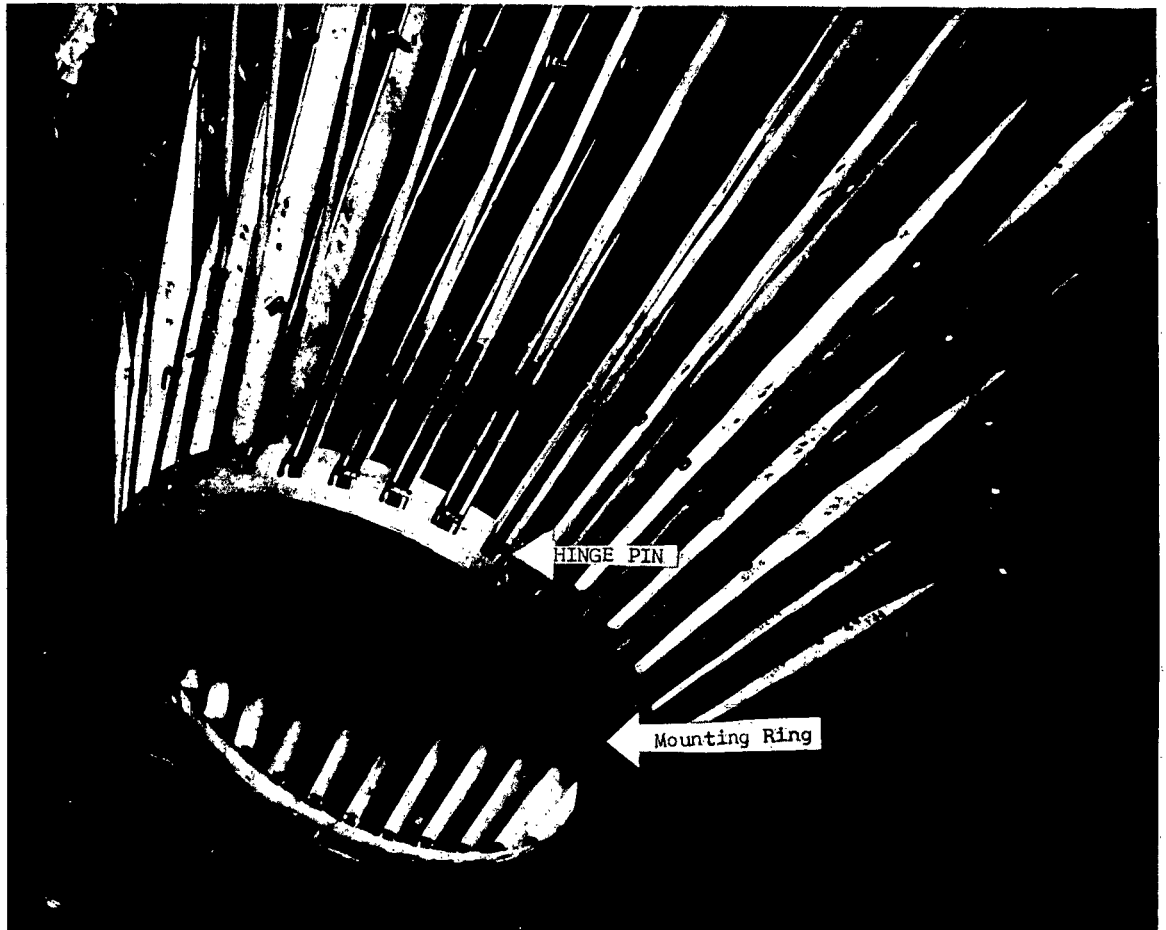


Figure 1

BEECH MODEL 485 UNIVERSAL AR DROGUE SHOWING THE
MOUNTING RING WITH LEAVES HOOKED TO HINGE PINS

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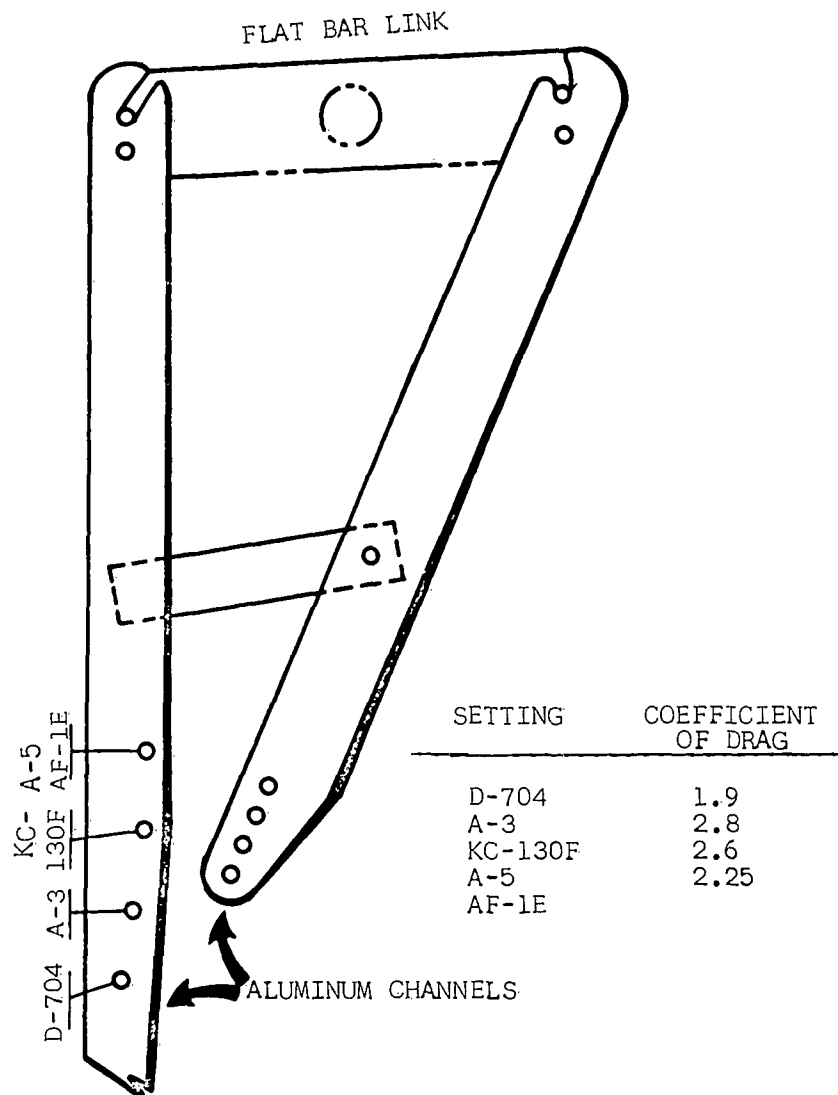


Figure 2

LEAF OF BEECH MODEL 485 UNIVERSAL AR
DROGUE SHOWING DRAG ADJUSTMENTS

4. AR Systems. All Navy AR systems employed in these tests utilize hydraulically operated, electrically actuated hose and reel assemblies with standard MA-2 reception couplings and collapsible drogues.

a. The Douglas model D-704 AR Store is carried externally on model A-4 or model A-6 airplanes. The production drogue is Dalmo Victor model DVR 90026 (figure 3).

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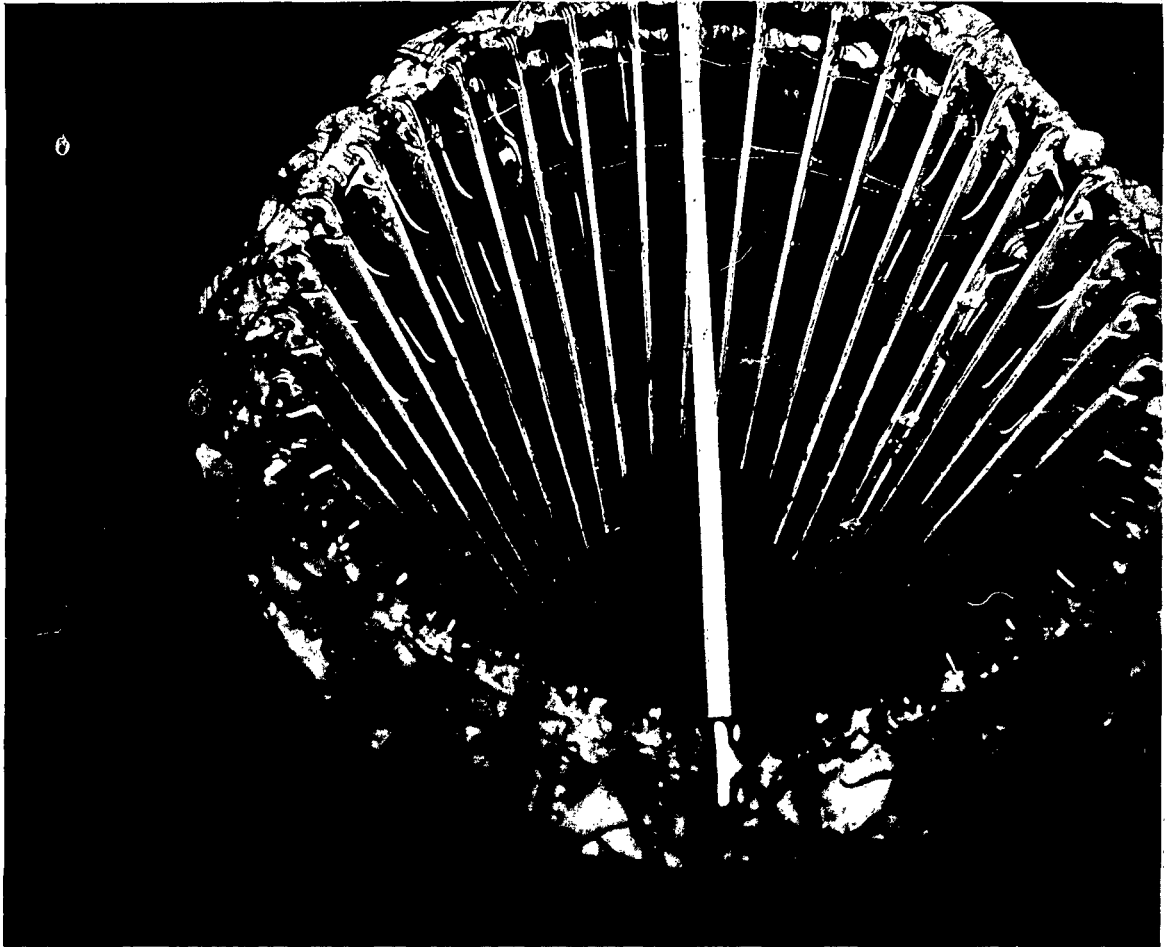


Figure 3

DALMO VICTOR AR DROGUE

b. The North American A-5 Tanker Package is designed for installation in the linear bomb bay of the model A-5A airplane. The hose and reel assembly is Fletcher Aviation model FR300 utilizing a Fletcher drogue (figure 4) and a special tail cone to collapse the drogue and support it in the stowed position.

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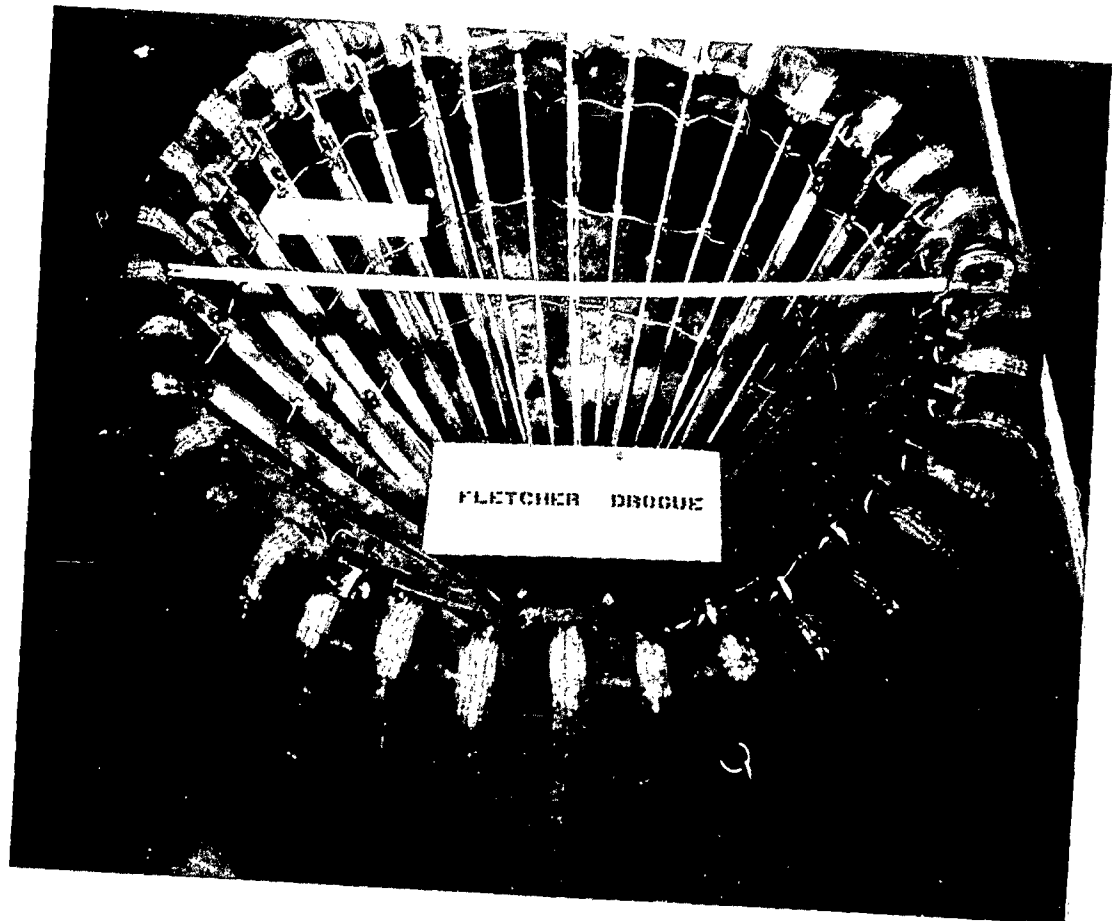


Figure 4

FLETCHER AR DROGUE SHOWING
SPRING CLIP ATTACHMENT OF PARACHUTE

c. The Lockheed KC-130F Tanker Package is designed to be carried in a wing mounted pod on the model KC-130F airplane. The hose and reel assembly is Fletcher Aviation model FR300B utilizing a Fletcher drogue.

d. The North American Buddy Tanker Package is carried externally on the model AF-1E airplane. The hose and reel assembly is manufactured by Flight Refueling Incorporated. The Buddy Tanker Package used in this evaluation was not operable and did not contain a hose and reel assembly.

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SCOPE AND METHOD OF TESTS

5. The test drogue was fit checked in each available AR system (paragraph 4) to determine physical fit in the drogue stowage tunnel and whether or not tunnel fabrication peculiarities existed which would affect ejection of the drogue from the fully retracted position. The maintainability of the test drogue was evaluated by comparing ease of installation, removal, disassembly, and parts replacement with the production drogues of available AR systems.

6. Flight test of the prototype universal drogue was limited to one flight attached to the Douglas D-704 AR Store installed on a model A-4C airplane. Extension and retraction times were recorded at altitudes of 20,000 and 30,000 ft at indicated airspeeds from 200 to 280 kt. The pilots of two receiver airplanes (models A-5A and A-6A) attempted AR engagements at the same altitudes and airspeeds, and observed the drogue during all extension and retraction cycles. Identical flight tests of the D-704 Store with the Dalmo Victor production drogue were conducted before and after tests of the prototype universal drogue for purposes of comparison and to verify adjustment and operation of the store.

RESULTS AND DISCUSSION

FIT CHECK

7. The test drogue was installed on the Douglas model D-704 AR Store and KC-130F Tanker Package; ejection and retraction operations were ground checked. The drogue did fit physically in the tunnels of both systems and no tunnel fabrication peculiarities were discovered which might affect ejection or retraction.

8. The test drogue did fit physically in the tunnels of the North American Buddy Tanker Package and the A-5 Tanker Package but a functional check was not performed. No tunnel fabrication peculiarities were discovered which might affect ejection or retraction.

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MAINTAINABILITY

Installation

9. Maintenance effort required for installation and removal of the test drogue was essentially the same as that required for the Dalmo Victor drogue on the Douglas model D-704 AR Store and the Fletcher drogue on the KC-130F and A-5 Tanker Packages.

Maintenance

10. Comparison with Dalmo Victor Drogue. The test drogue was more easily maintained than the Dalmo Victor drogue because disassembly and parts replacement were less difficult and less time consuming.

11. Comparison with Fletcher Drogue. The test drogue was superior to the Fletcher drogue in ease of replacement of mounting ring and leaves. Replacement of these sub-assemblies on the test drogue required relatively simple class E maintenance. Replacement of these subassemblies on the Fletcher drogue requires drilling and riveting and is normally performed as class D maintenance at the squadron level or by a component repair activity.

12. The test drogue was inferior to the Fletcher drogue in ease of parachute assembly replacement. To replace this subassembly on the test drogue required removal and re-installation of 36 cotter pins and 36 straight-headed pins. On the Fletcher drogue, spring clips secure the parachute assembly (figure 4) and replacement can be performed without the use of tools. An improved system of parachute attachment on the test drogue is desirable for improved service use.

13. General. The improvements in the maintainability of the test drogue over production drogues were significant in that all repairs to the test drogue could be made expeditiously at the class E maintenance level without removing the drogue from the airplane. Use of the universal drogue on all Navy AR systems would simplify logistic support by reducing the variety of spares presently being procured. Improved maintainability and simplified logistic support justify continued research and development to obtain a satisfactory universal AR drogue.

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FLIGHT TEST

14. The test drogue operated satisfactorily as a component part of the Douglas model D-704 AR Store during extension and retraction cycles within the limited flight envelope (paragraph 6). Extension and retraction times were the same with the test drogue as with the Dalmo Victor production drogue. The drag of the test drogue was satisfactory for use on the Douglas model D-704 AR Store. The drogue was stable during the extension and retraction cycles.

15. During AR approaches to the universal drogue pressure fields of the receiver airplanes forced the drogue upward and/or outward. This condition made the test drogue more difficult to contact than the Dalmo Victor drogue. When probe contacts were obtained at various off-center radial positions on the drogue, it did not have sufficient stability to guide the coupling onto the probe nozzle. The drogue repeatedly tumbled and slipped off the probe nozzle. Only one successful engagement was accomplished and this was the result of a dead center contact. Provision for adequate stability of the universal drogue during the AR approach and probe contact is mandatory for satisfactory service use.

16. Structural integrity of the test drogue was unsatisfactory. During disengagement from the one successful AR engagement, the probe nozzle of the A-6A became entangled with the cables in the drogue parachute and was observed to withdraw between leaves breaking two of the three cables in the parachute. Two lengths of cable and several swaged balls separated from the drogue and were not recovered (figure 5). Several of the leaves were distorted at the slots which normally retain the swaged balls (figure 6). Poor structural integrity and the debris resulting from damage to the drogue constitute a serious foreign object damage hazard to receiver airplanes. Correction of this deficiency is mandatory for satisfactory service use.

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Figure 5

DAMAGE TO BEECH MODEL 485 UNIVERSAL AR DROGUE

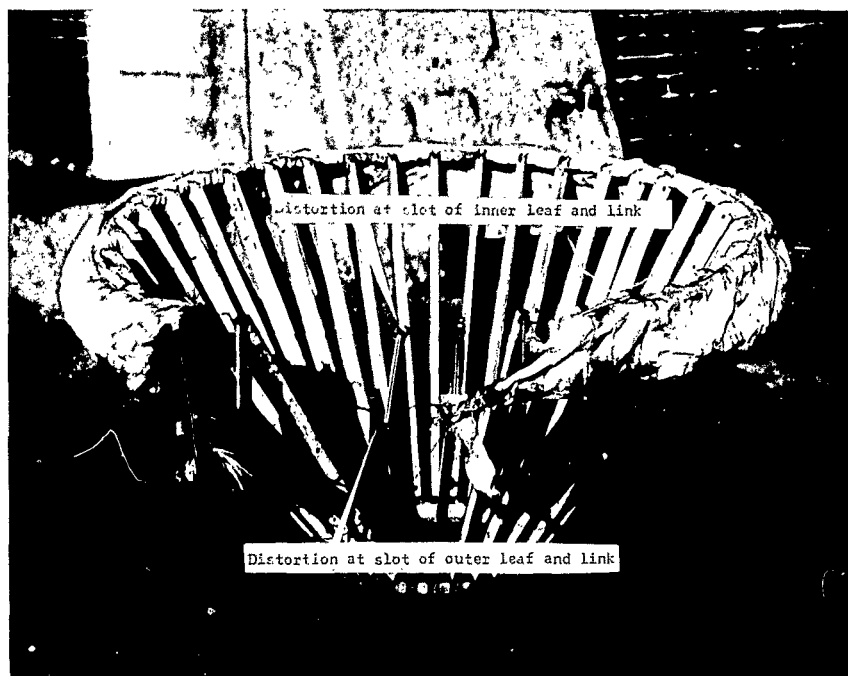


Figure 6

DAMAGE TO BEECH MODEL 485 UNIVERSAL AR DROGUE

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CONCLUSIONS

17. It is concluded that:

a. To the extent tested, the Beech model 485 universal AR drogue:

(1) Was physically compatible with the Navy AR systems available (paragraphs 7, 8, and 14).

(2) Provided advantages in maintenance and interchangeability of parts over the production drogues of Navy AR systems available (paragraphs 10 and 11).

b. The benefits of improved maintainability and simplified logistic support which would be derived from a satisfactory universal AR drogue justify continued research and development (paragraph 13).

c. Correction of the following deficiencies of the Beech model 485 universal AR drogue is mandatory for satisfactory service use:

(1) Insufficient stability during AR approaches and probe contact (paragraph 15).

(2) Unsatisfactory structural integrity and resultant foreign object damage hazard to receiver airplanes (paragraph 16).

d. Correction of the inferior method of parachute attachment to the drogue is desirable for improved service use (paragraph 12).

RECOMMENDATIONS

18. It is recommended that:

a. The Beech model 485 universal air refueling drogue not be accepted for service use.

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b. Research and development be continued to obtain
a satisfactory universal air refueling drogue.

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